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A Low Noise Model for Rotational Ground Motions

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The quantitative low/high noise models (L/HNM) for translational ground motions (e.g., Petersen 1993) based on many observations of acceleration power-spectral densities has been extremely successful for the evaluation of site quality, as well as the development of seismic sensors for passive experiments on Earth. No such L/HNM exists for rotational ground motions, primarily because 1) there are close to no direct sensors that measure below the Earth's smallest rotational motions (large ring laser are currently the most sensitive instruments), and 2) small-scale seismic arrays can be used to derive rotational motions, but are limited in frequency range. A (even approximate) rotational L/HNM would be useful in particular for the development of new rotation sensors considering the numerous possible applications of 6 degree-of-freedom observations in terrestrial and planetary seismology as well as ocean bottom observations. As the terrestrial low-noise motion is primarily dominated by surface waves, the well-known connection between plane surface waves and rotational motions can be used to estimate rotational motions from classic seismometer records using local velocity information. We propose a methodology to derive a rotational L/HNM and support the model by ring laser and seismic array observations.